

Comparison with publication

1 Introduction

As part of a comparison study of slope stability methods, Fredlund and Krahn (1977) analyzed the stability of an embankment resting on a bedrock stratum with the presence of a weak layer on the bedrock surface. They used the original Morgenstern-Price computer program, as modified at the University of Alberta, (Krahn, Price and Morgenstern, 1971), and compared it with a slope stability program developed by Fredlund, 1974, at the University of Saskatchewan. The purpose of this example is to compare the SLOPE/W solution with the solutions obtained from both the University of Alberta and the University of Saskatchewan. Features of this simulation include:

- Analysis method: Morgenstern-Price (with constant interslice force function)
- Development of a composite slip surface
- Pore water pressure modeled with a piezometric line
- Grid and Radius: Using a single slip surface for comparison purposes
- Multiple analyses

2 Configuration and setup

Figure 1 illustrates the geometry and strata of the example. For the main soil, the unit weight = 120 pcf, $C = 600$ psf and $\Phi = 20$ degrees. For the weak layer, the unit weight = 120 pcf, $C = 0$ and $\Phi = 10$ degrees. The pore water pressure is either described by the depicted piezometric line or by a R_u value of 0.25.

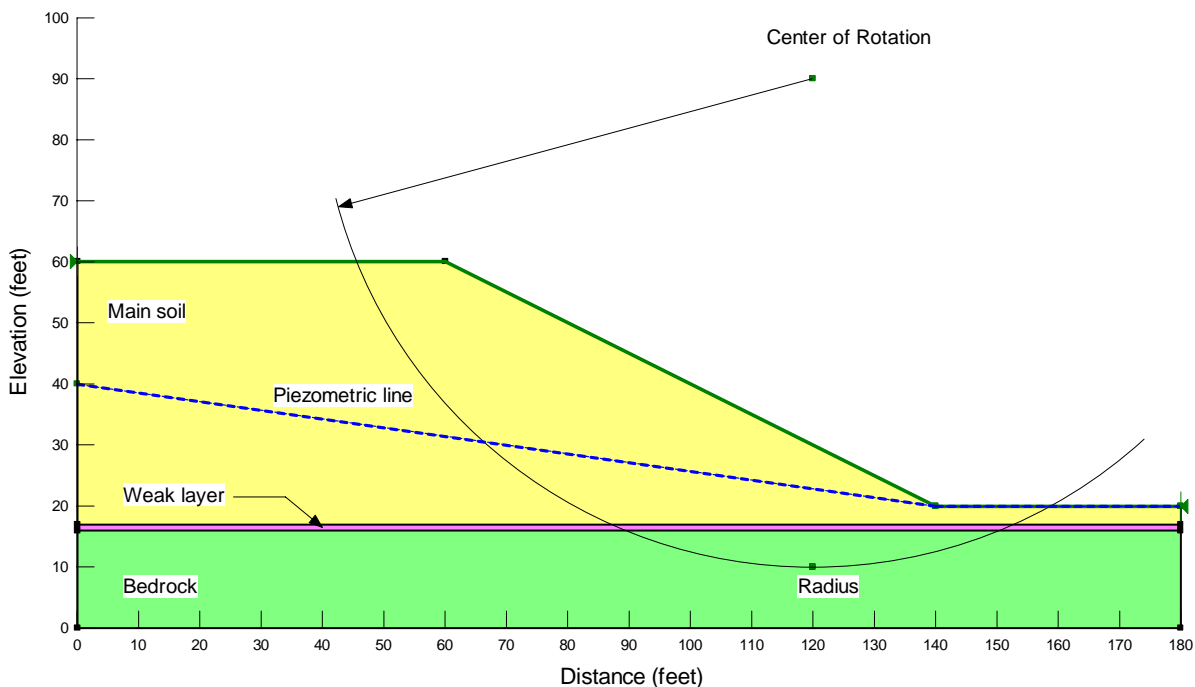


Figure 1 Geometry and Material Strata of Example Showing a Single Trial Slip Surface

3 Solution from U of A and U of S

The soil properties and the pore-water pressure conditions of the slope were varied to simulate six different cases in the analyses. **Error! Reference source not found.** presents the factors of safety and lambda values as computed by the University of Alberta, University of Saskatchewan and the SLOPE/W computer programs with constant side force functions.

Table 3 Comparison of SLOPE/W with other computer programs

Case	Description	U of A		U of S		SLOPE/W	
		F of S	λ	F of S	λ	F of S	λ
1	No pore-water pressure, no weak layer, no bedrock	2.085	0.257	2.076	0.254	2.074	0.2592
2	No pore-water pressure, with weak layer & bedrock	1.394	0.182	1.378	0.159	1.341	0.1761
3	With $r_u = 0.25$, no weak layer, no bedrock	1.772	0.351	1.765	0.244	1.760	0.2507
4	With $r_u = 0.25$, with weak layer & bedrock	1.137	0.334	1.124	0.116	1.084	0.1504
5	With piezometric line, no weak layer, no bedrock.	1.838	0.270	1.833	0.234	1.830	0.2421
6	With piezometric line, with weak layer & bedrock	1.265	0.159	1.250	0.097	1.214	0.1215

4 SLOPE/W Solutions

The problem shown in Figure 1 was re-analyzed with SLOPE/W. As shown **Error! Reference source not found.**, SLOPE/W gives essentially the same factors of safety as the University of Alberta and University of Saskatchewan computer program. The small differences are principally due to slight differences in geometric interpretation of the sections, and different procedures for subdividing the potential sliding mass into slices.

Multiple analyses on the same geometry can be done quite easily with GeoStudio. In this example, a total of 6 analyses were created to model the above 6 cases. Figures 2 to 7 illustrate the SLOPE/W solution for the different cases.

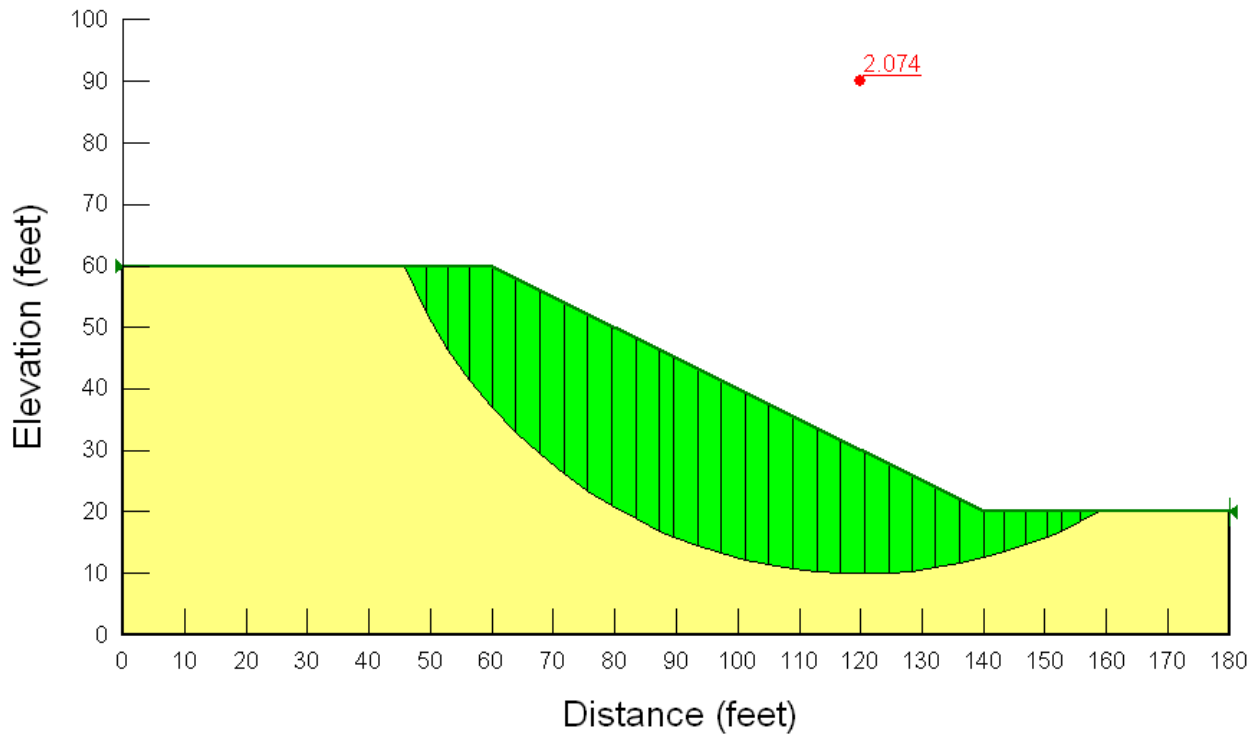


Figure 2 Factor of safety and slip surface computed by SLOPE/W for Case 1

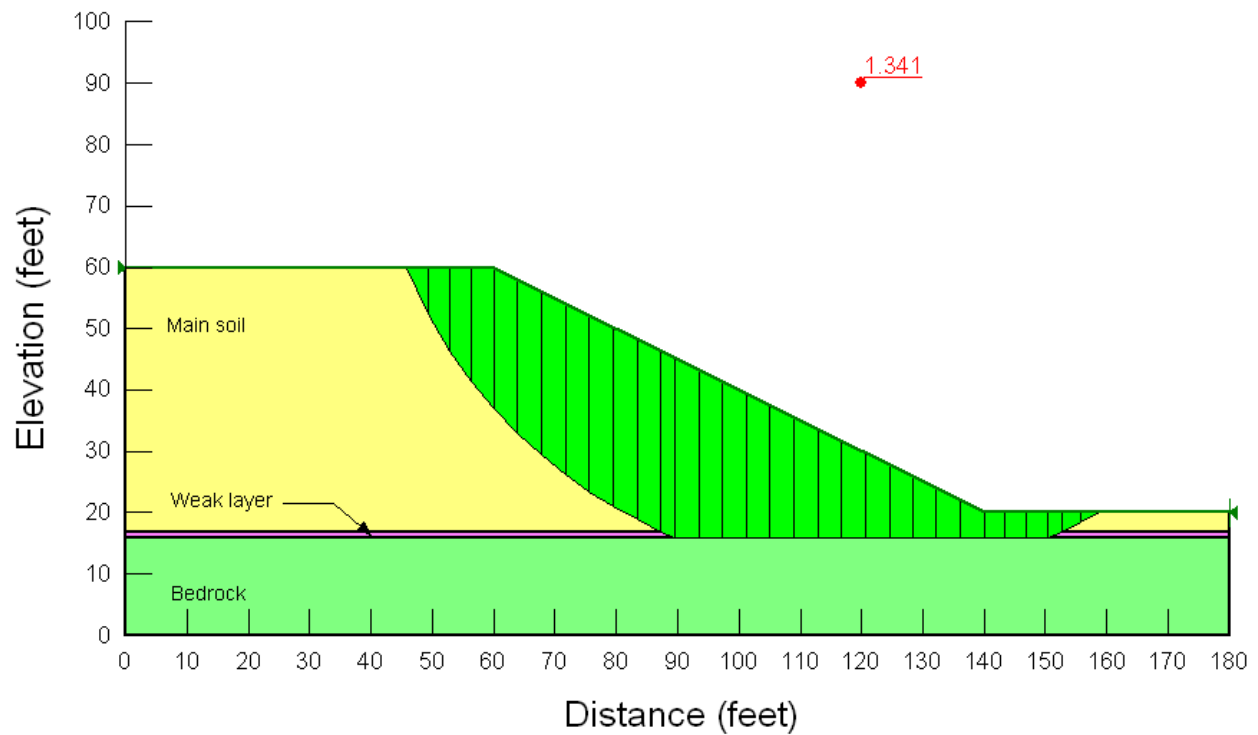


Figure 3 Factor of safety and slip surface computed by SLOPE/W for Case 2

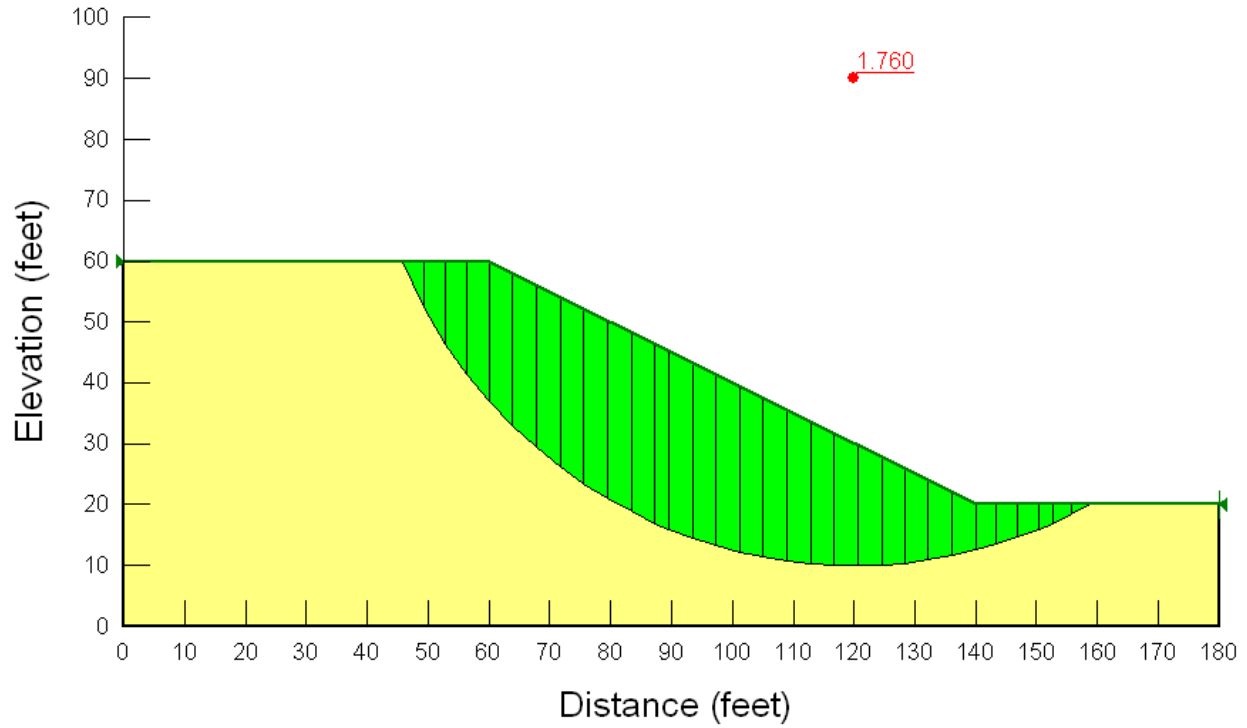


Figure 4 Factor of safety and slip surface computed by SLOPE/W for Case 3

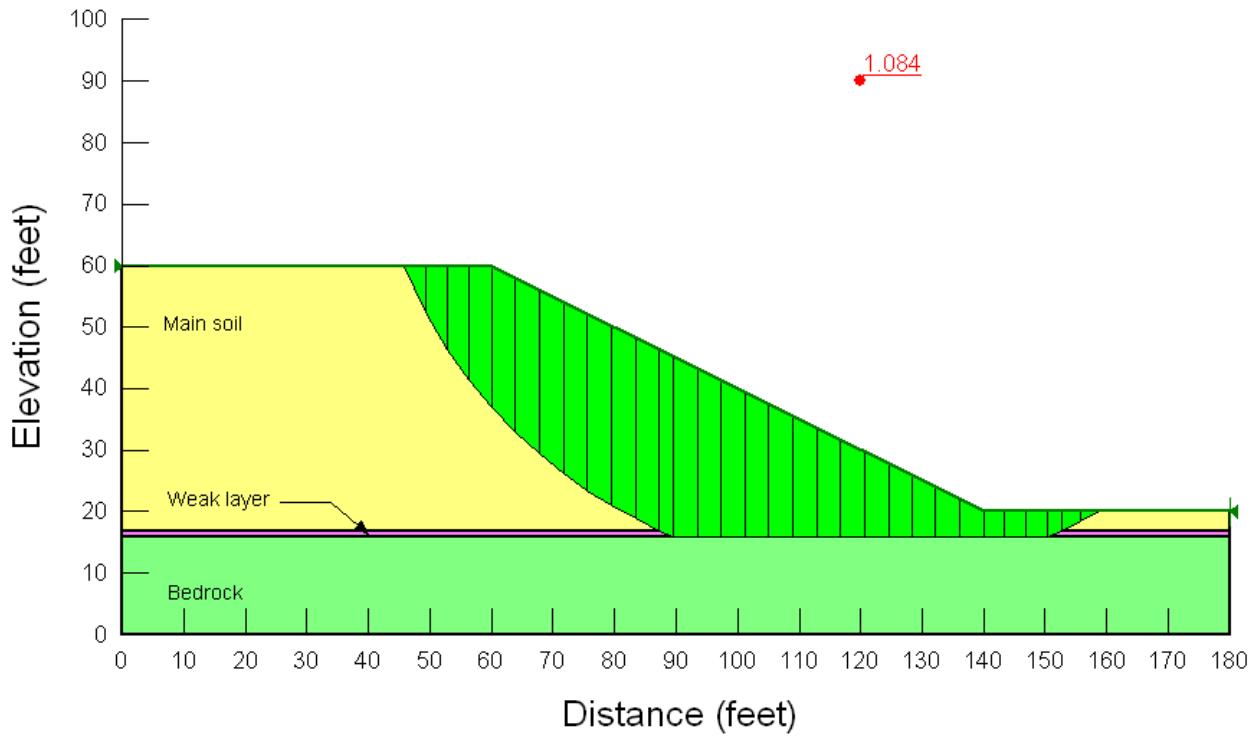


Figure 5 Factor of safety and slip surface computed by SLOPE/W for Case 4

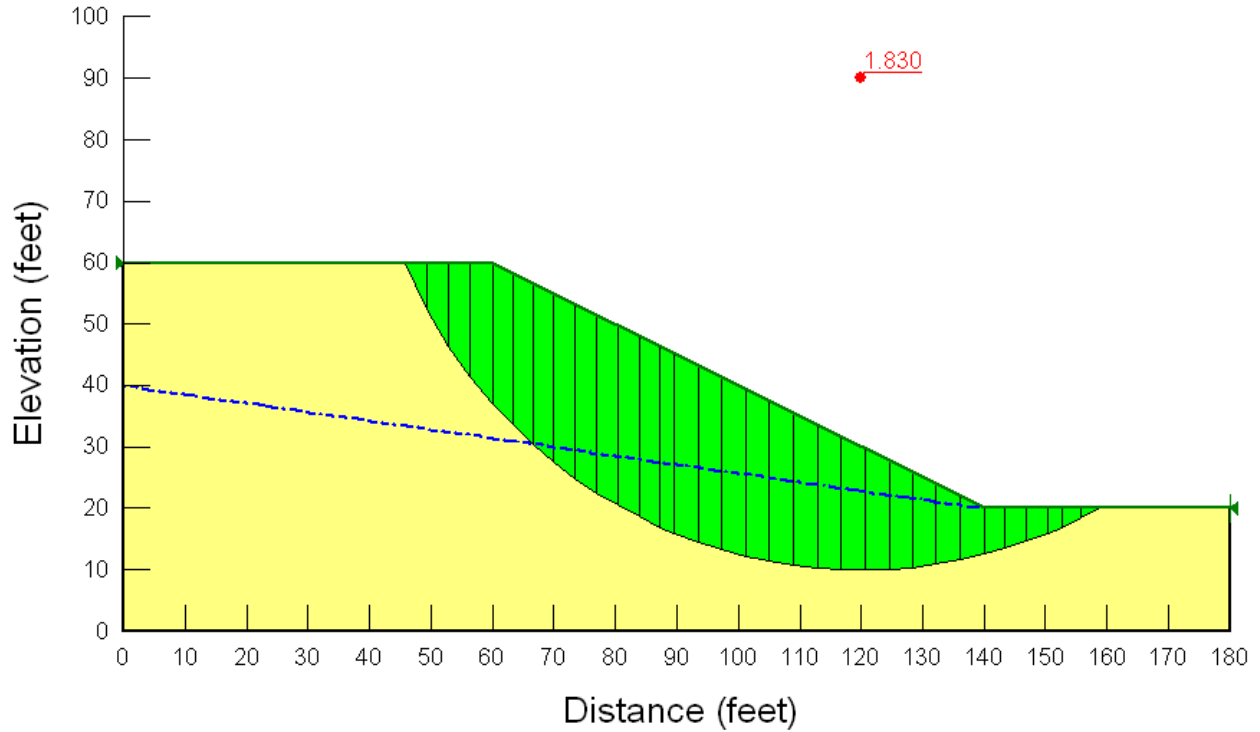


Figure 6 Factor of safety and slip surface computed by SLOPE/W for Case 5

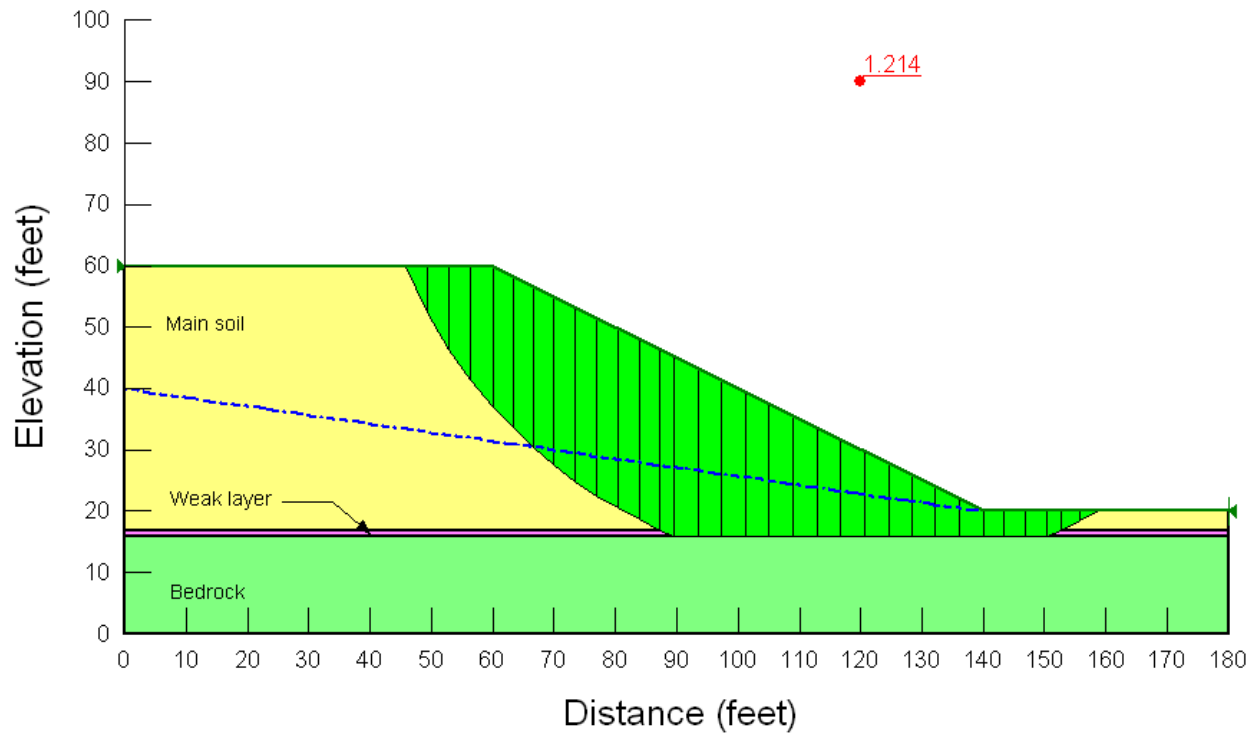


Figure 7 Factor of safety and slip surface computed by SLOPE/W for Case 6

Note that in order to compare results of the different cases, a single slip surface is used. To create a single slip surface, the grid and radius slip surface option was utilized, but the search grid was represented by a single center of rotation and the search radii were reduced to a single radius as shown in Figure 1.

5 Conclusion

SLOPE/W gives essentially the same factor of safety as the published solutions by Fredlund and Krahn (1977), who used the stability programs from University of Alberta and the University of Saskatchewan. This confirms that SLOPE/W is formulated correctly.